Hydropower Investment Promotion Project (HIPP)

Projected Thermal Power Requirements for the Georgian Power Market

OCTOBER, 2011

This publication was produced for review by the United States Agency for International Development. It was prepared by Deloitte Consulting.

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USAID HYDROPOWER INVESTMENT PROMOTION PROJECT (HIPP)

CONTRACT NUMBER: EEM-I-00-07-00005-0

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USAID/CAUCASUS OFFICE OF ENERGY AND ENVIRONMENT

OCTOBER, 2011

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Projected Thermal Power Requirements for the Georgian Power Market

1. Introduction

The Hydropower Investment Promotion Project (HIPP) Special Studies Group evaluated the performance of HIPP in meeting the overarching goal of the project, *"...which is to facilitate private sector development of at least 400 MW of new, climate friendly hydropower, enough to eliminate winter imports and greatly reduce the use of natural gas for electricity production*." Because Georgia no longer imports power in the winter time, the Special Studies Group focused on the impact of new run-of-river hydropower (HPPs) on projected gas-fired electricity production in the winter months.

This report provides a summary of the contribution of new small and medium size run-of-river hydropower plants to meet country's future electricity demand. The current situation (2010) was analyzed and then different scenarios for consumption growth and production levels were considered. Finally, the role of small and medium size HPPs to substitute thermal power plants (TPPs) was analyzed.

2. Current situation in the Power Sector

Starting from 2007 Georgia has become a net exporter of electricity. Last year (2010), electricity exports peaked, reaching 1,524 TWh. The largest importer country for Georgian electricity appeared to be Russia (1.1 TWh) followed by Turkey (0.3 TWh)[1]. The production of electricity is higher during spring-summer time and substantially lower in winter time, when the

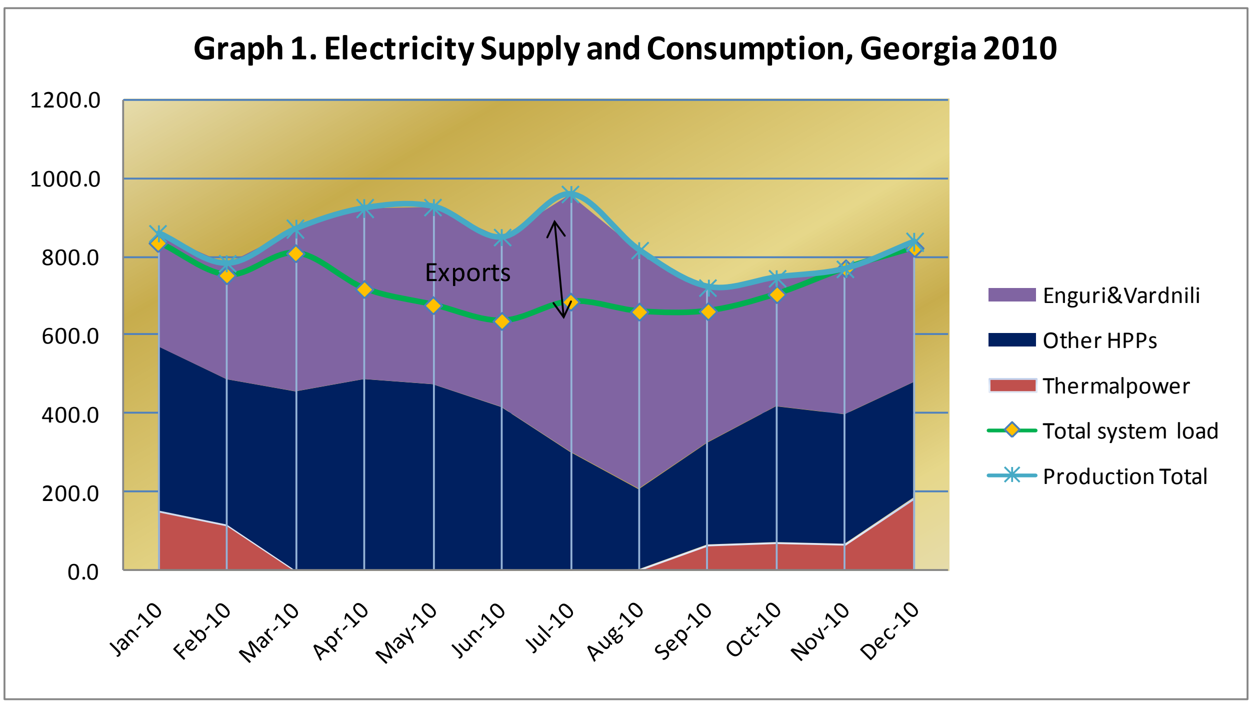
[1] Source: ESCO

demand for electricity is higher in Georgia. Table 1 below shows monthly consumption and production of power in Georgia for year 2010.

Table1. Energy balance 2010, source: ESCO

	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Total
Consumption	**835.1**	**752.2**	**808.6**	**716.8**	**675.4**	**635.0**	**684.5**	**658.9**	**660.2**	**703.6**	**769.7**	**822.3**	**8722.5**
Thermalpower	153.9	118.1	1.5	2.0	0.1	4.3	1.6	4.5	67.5	73.4	69.3	186.3	***682.7***
Other HPPs	417.2	369.0	454.7	485.6	474.4	412.3	301.0	203.0	258.5	344.9	328.7	293.4	***4342.5***
Enguri&Vardnili	287.5	294.4	414.5	435.9	452.5	432.1	656.4	607.6	395.7	327.8	370.2	357.8	***5032.4***
Production Total	**858.6**	**781.5**	**870.7**	**923.5**	**927.1**	**848.7**	**959.0**	**815.2**	**721.6**	**746.1**	**768.2**	**837.4**	***10057.6***

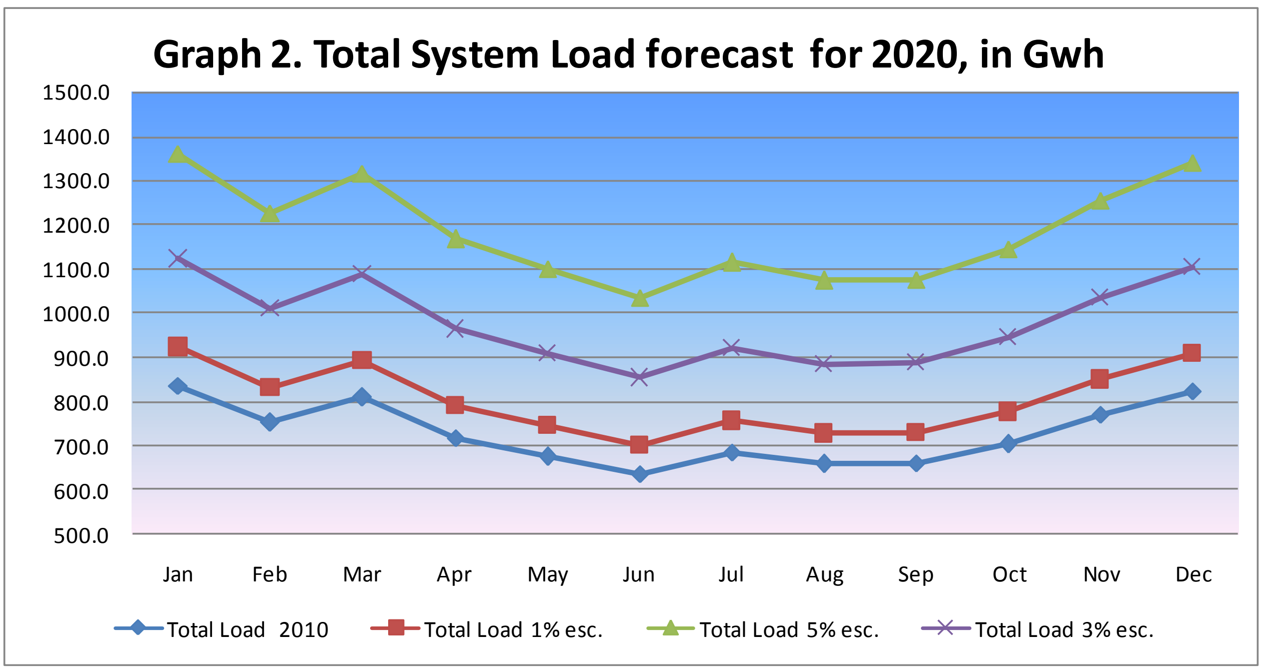
During the winter, TPPs operate in order to compensate for the reduction of power generation by HPPs and secondly to satisfy higher demand. Graph 1 depicts production of electricity by TPPs and HPPs for the year, 2010.



3. Consumption Forecasts

The data of domestic electricity consumption was extracted from ESCO's web page. Under the term "consumption" ESCO means Total System Load, since ESCO defines consumption as total generation plus import, minus export.

The Special Studies Group forecasted Total System Load Growth for two key years for the analyses, years of 2015 and 2020. There are 3 scenarios of system load growth - low (1%), expected (3%) and high (5%). Graph 2 below shows projected total system load at different growth scenarios for the year 2020. Total system load in 2010 is taken as the base year and then monthly numbers are enlarged by 1%, 3% and 5% at an annual compound growth rate. This approach assumes that consumption patterns will not change in the future, in other words, total system load will have the same load shape for the years of 2015 and 2020 as it had in 2010. The consumption of electricity in Georgia reaches maximum in January and minimum in June.



4. Electricity Generation forecasts

HIPP's Special Studies Group analyzed current data and information about new HPPs and developed a table on an annual basis. The HPPs that are under the construction or are expected to be built in the near future are presented on the Table 2. The sites in green color are HPP that were identified by the HIPP project.

Table2. Productions of new HPPs (in GWh) that are expected to start operate from 2011 to 2020.

	Name Of HPP	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	Khadori 1	100	100	100	100	100	100	100	100	100	100
2	Chelti		28	28	28	28	28	28	28	28	28
3	Bakhvi			35	35	35	35	35	35	35	35
4	Khadori 2			35	35	35	35	35	35	35	35
5	Lukhuni				74	74	74	74	74	74	140
6	Mtkvari				200	200	200	200	200	200	200
7	Paravani				425	425	425	425	425	425	425
8	Stori				44	100	142	197	197	197	197
9	Aragvi				50	50	50	50	50	50	50
10	Dariali					521	521	521	521	521	521
11	Machakhela					130	262	262	262	262	262
12	W&B Aragvi					66	110	154	154	154	154
13	Tsageri						522	522	522	522	522
14	Lentekhi						551	551	551	551	551
15	Tsablari								40	110	110
16	Khani								32.12	82.28	111.76
	Total	**100**	**128**	**198**	**991**	**1764**	**3055**	**3154**	**3226.12**	**3346.28**	**3441.76**

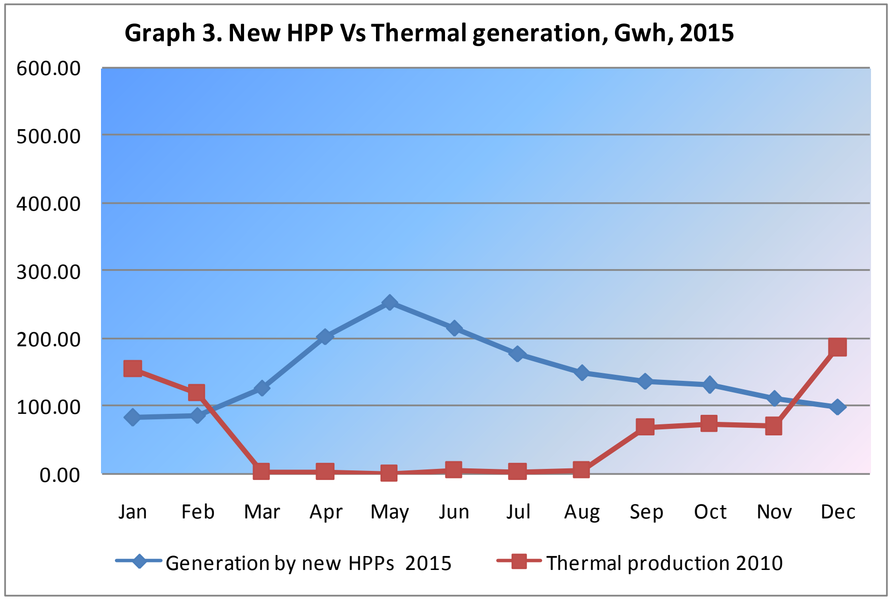
According to the data presented in Table 2, by the end of the 2015 new HPPs will add 1764 GWh annual production. This number will increase up to 3441 GWh by the end of the year 2020.

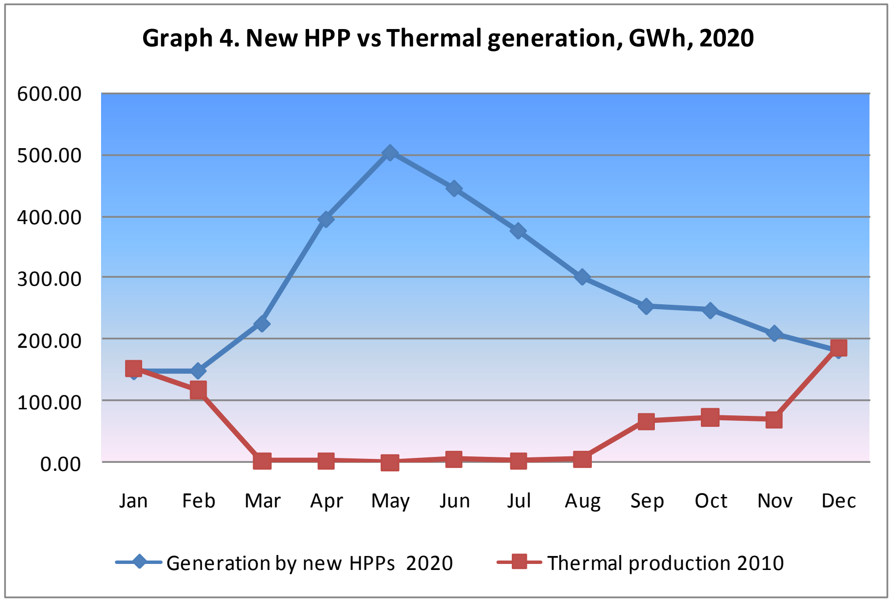
Besides annual generation, monthly generation of new HPPs was also analyzed in order to observe seasonal demand/supply interactions. Additionally, Section 5 provides scenarios and analyses for the case if new HPPs can substitute production by thermal power plants.

5. Thermal Power needs and forecasts

Currently TPPs generate electricity from September through March in Georgia (they have must-run status). Because TPPs in Georgia mainly use imported natural gas as their fuel source, electricity generated from TPPs is more expensive. Additionally negative environmental externalities from TPPs make new HPPs more attractive from the country's perspective. Energy security and cleaner environment are major reasons to substitute existing TPPs by new HPPs.

If all the projects discussed on section 4 will succeed it is fascinating to analyze how those projects will substitute TPP production during winter time, Graphs 3 and 4 depict comparison between electricity production by new HPPs and by current TPPs for the years of 2015 and 2020.



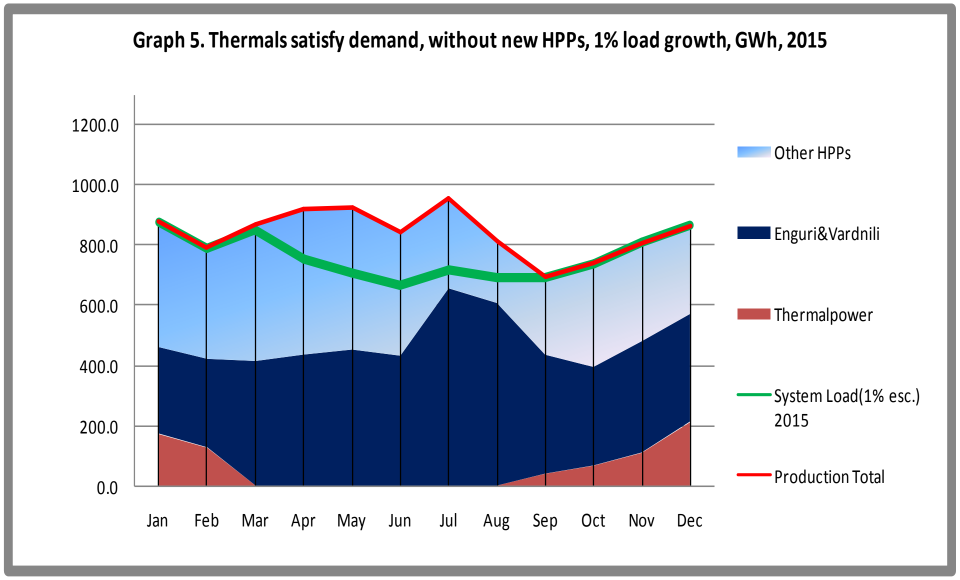


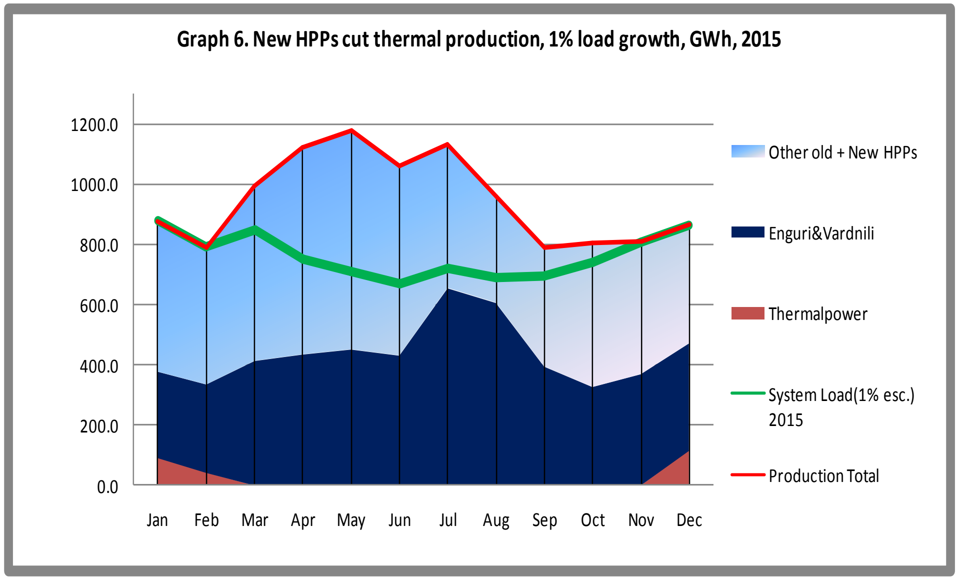
Now we will observe different options how increased demand could be satisfied. Again 3 growth scenarios (low, expected and high) are considered for the years of 2015 and 2020.

5.1 Low total system load growth scenario

Graph 5 below depicts scenario when no new HPPs are being built and thermal production satisfies winter generation. In such case thermal production should rise slightly, by 1.06 times.

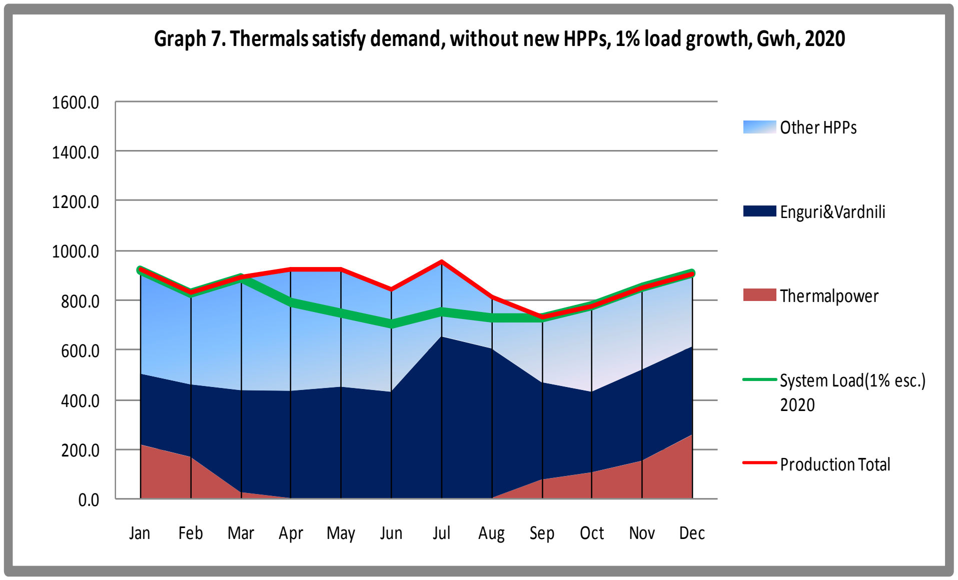
This scenario - adding new HPP productions, with 1% growth of system load and reduce thermal power production for the year of 2015 - is depicted in Graph 6. In this case new HPPs reduce thermal production by 2.8 times (from 682 Gwh to 247 Gwh).

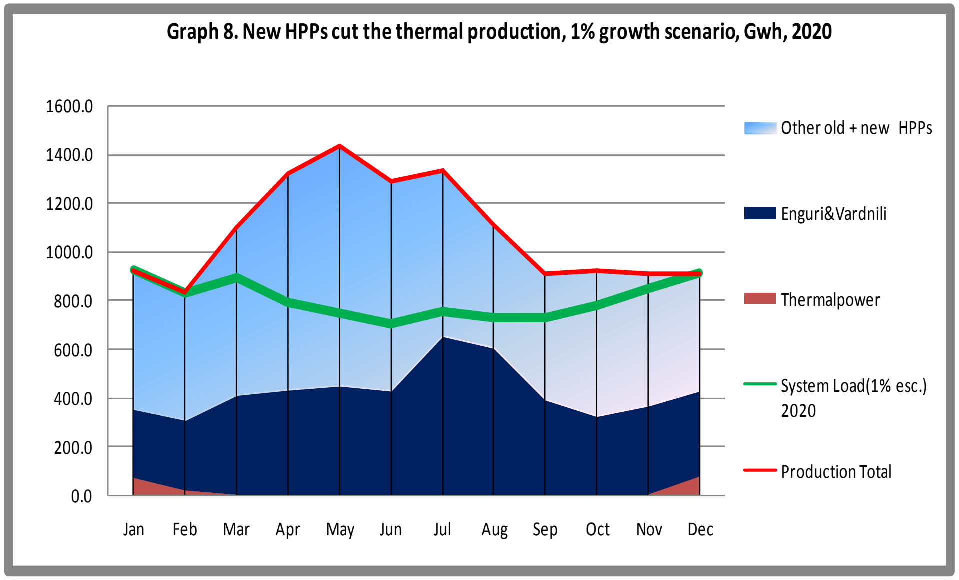




Graph 7 and 8 describe the same scenario as prevous two graphs but for the year of 2020. In the Graph 7, thermal power has increased in order to satisfy domestic demand. Compared to the 2010 year level thermal power generation should increase by 1.5 times in order to satisfy domestic consumption.

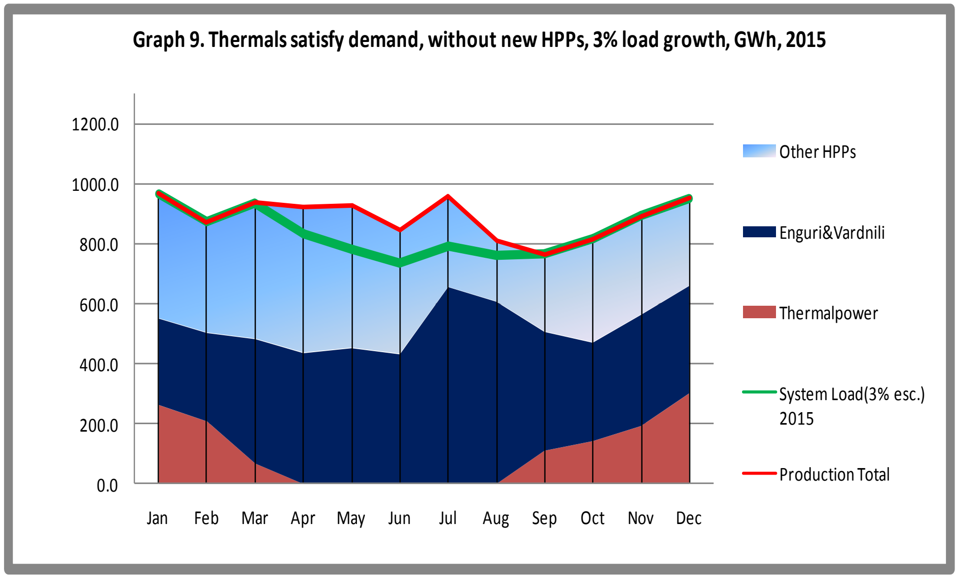
If all HPP projects, listed on the Table 2, succeed, than in 1% load growth scenario new hydro plants will reduce thermal power production by 4.25 times for the year of 2020. Graph 8 below shows this case.

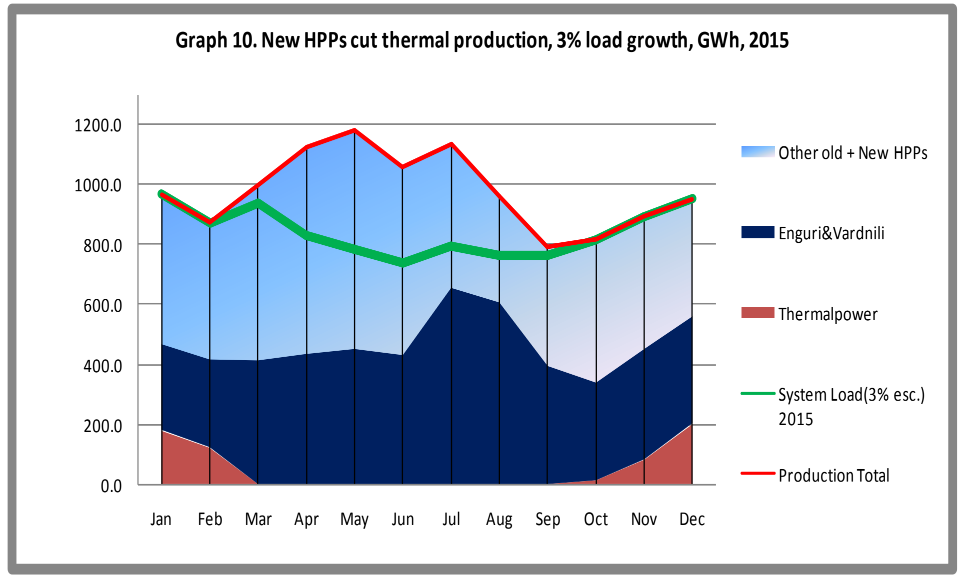




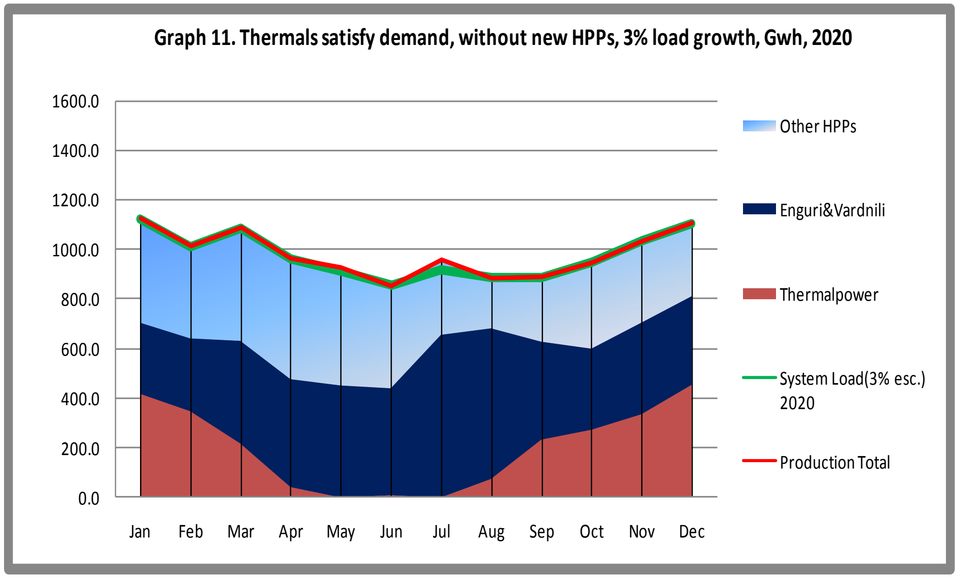
5.2 Expected Growth Scenario

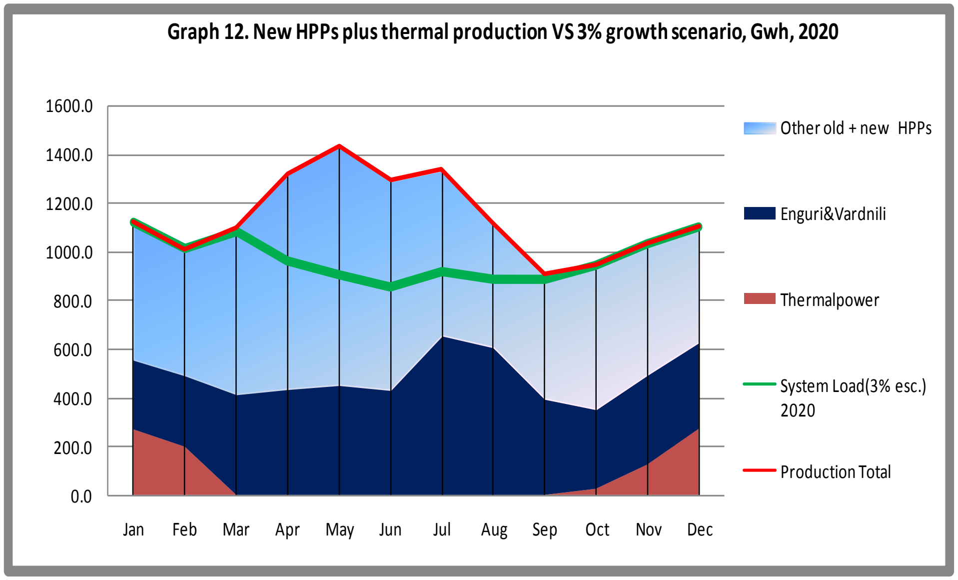
If demand grows by 3 % at the end of the 2015, without adding new HPPs generation, thermal production should grow by 1.9 times (See Graph 9). New HPPs cut thermal power generation by 12% for the year of 2015 (See Graph 10).





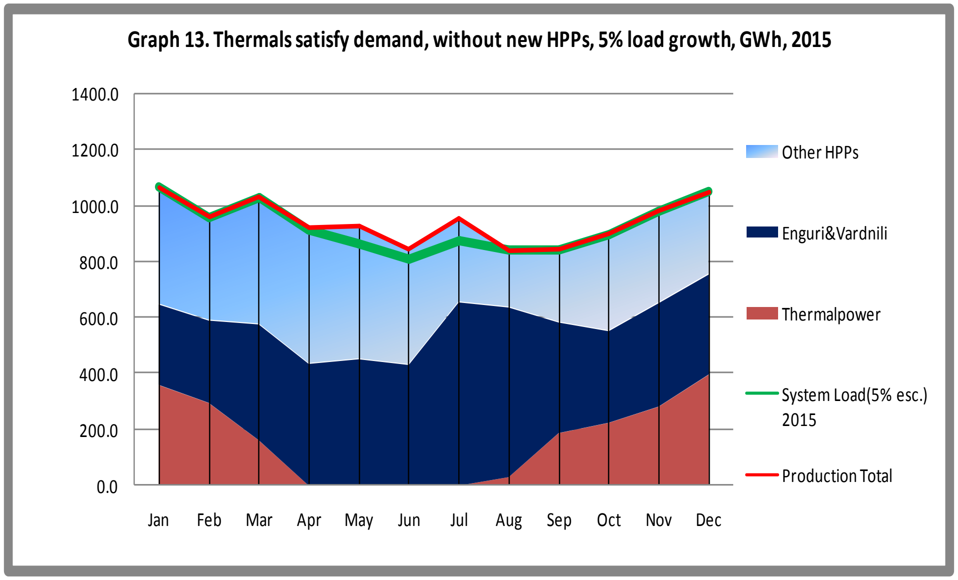
Without new HPPs thermal power generation should increase by 3.5 times for the year 2020 (Graph 11). New HPPs can satisfy most of increased demand; however thermal power production should increase by 1.3 times (see graph 12).

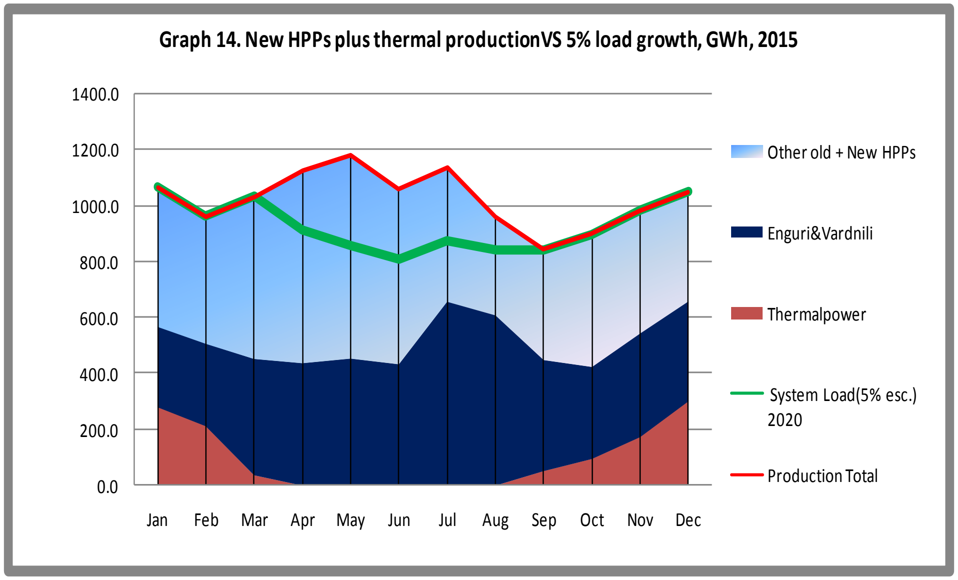




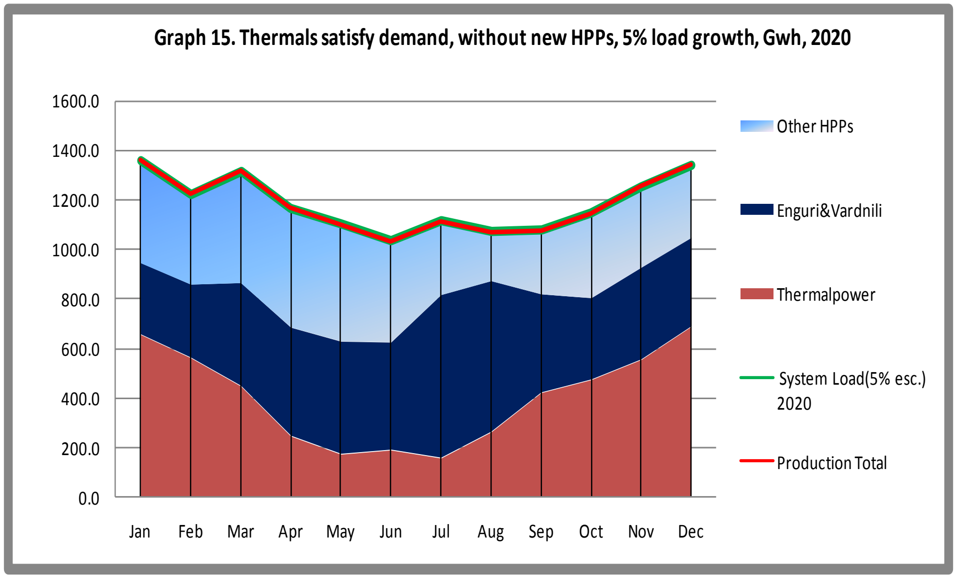
5.3 High demand growth scenario

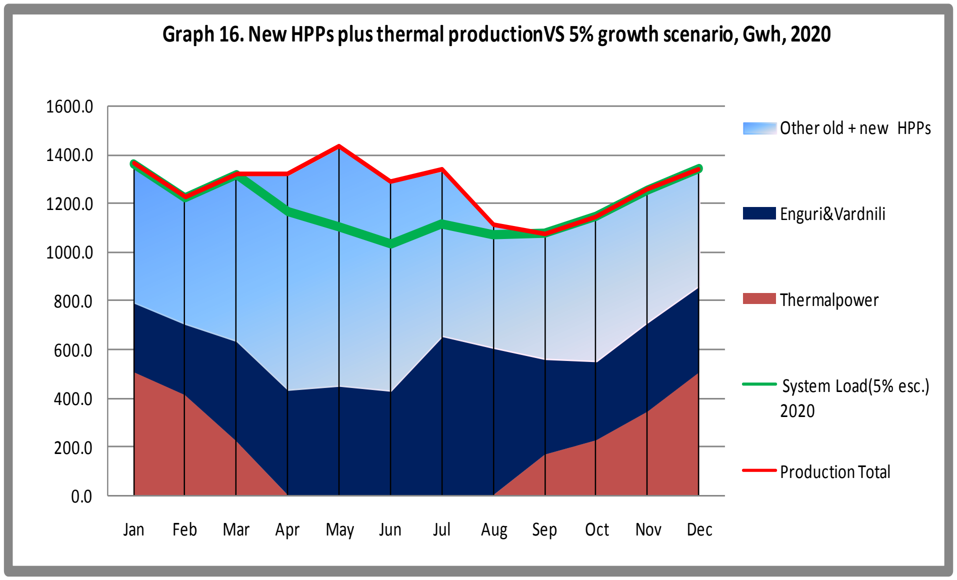
Without new HPPs, thermal power production would increase by 2.9 times in order to meet annually by 5% escalated total system load for the year of 2015 (see graph 13).
When new HPPs are added in the system thermal power production would increase by 1.68 times in order to satisfy 5% load growth for the year of 2015 (see Graph 14).





More thermal power production will be required to satisfy total system load for the year of 2020, in case of 5% load growth and no adding new HPPs thermal power would increase by 7.1 times (Graph 15).
Even if total system load will grow by 5% annually, new HPPs can export electricity during summer time, however thermal production should increase by 3.5 times in order to satisfy winter demand in Georgia (see Graph 16).





Conclusions:

New HPPs will deliver significant winter time energy, averaging about 30% of their annual energy production. This has obvious benefits to the country in increasing energy security and reducing harmful emissions from thermal power plants.

We can conclude that:

1) For system demand growing on average 1% annually, new HPPs can produce excess energy during summer time and what is important they can reduce substantially TPP production. In case of all HPPs will be constructed listed on Table 2, thermal power production will be reduced by 2.8 times for the year of 2015 and by 4.25 times for the year of 2020, which significantly will lower CO_2 emissions and will reduce Georgia's dependency on imported natural gas for production of electricity.
2) For system demand growing on average 3% annually, new HPPs cover more than increased winter demand and cut thermal production by 12 % for the year of 2015. However, for the 2020 year new HPPs cannot satisfy winter demand growth and additionally thermal power production should increase by 1.3 times. During the summer time for both years, there is excess supply of electricity that could be exported.
3) For system demand growing on average 5% annually, winter demand growth could not be covered by existing production, plus existing and new HPPs production. In both years thermal power production would increase, by 1.68 times for the year of 2015 and by 3.5 times for the year of 2020. However, even in this high demand growth scenario, new run of river HPPs can supply excess electricity during summer time that can be exported.

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